

# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

# PCT

To:

FISH & RICHARDSON P.C.  
Attn. Thompson, Dwight U.  
P.O. Box 1022  
Minneapolis MN 55440-1022  
UNITED STATES OF AMERICA

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT AND  
THE WRITTEN OPINION OF THE INTERNATIONAL  
SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 09991-191W01	Date of mailing (day/month/year) 17/03/2006
International application No. PCT/US2005/040288	International filing date (day/month/year) 04/11/2005
Applicant  DIMATRIX, INC.	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

**Where?** Directly to the International Bureau of WIPO, 34 chemin des Colombettes  
1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

**For more detailed instructions,** see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

- ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.  
☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

**4. Reminders**


Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the International Searching Authority  European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  Johannes Van Brummelen
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## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the *PCT Applicant's Guide*, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report and the written opinion of the International Searching Authority, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only (see *PCT Applicant's Guide*, Volume I/A, Annexes B1 and B2).

The attention of the applicant is drawn to the fact that amendments to the claims under Article 19 are not allowed where the International Searching Authority has declared, under Article 17(2), that no international search report would be established (see *PCT Applicant's Guide*, Volume I/A, paragraph 296).

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Section 205(b)).

**The amendments must be made in the language in which the international application is to be published.**

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

**The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.**

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 09991-191WO1	<b>FOR FURTHER ACTION</b> see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US2005/040288	International filing date (day/month/year) 04/11/2005	(Earliest) Priority Date (day/month/year) 05/11/2004
Applicant  DIMATRIX, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed  
☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 11a

- ☒ as suggested by the applicant  
☐ as selected by this Authority, because the applicant failed to suggest a figure  
☐ as selected by this Authority, because this figure better characterizes the invention

b. ☐ none of the figures is to be published with the abstract

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2005/040288

**A. CLASSIFICATION OF SUBJECT MATTER**  
B41J2/045

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**Minimum documentation searched (classification system followed by classification symbols)  
B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/000560 A (RICOH COMPANY, LTD; AOKI, SUMIAKI) 31 December 2003 (2003-12-31) page 6, line 20 - page 8, line 25 page 28, line 7 - page 43, line 1 -----	1-3, 5-11, 13-23
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 16, 8 May 2001 (2001-05-08) & JP 2001 010035 A (SEIKO EPSON CORP), 16 January 2001 (2001-01-16) abstract -----	1, 13, 20
X	PATENT ABSTRACTS OF JAPAN vol. 007, no. 145 (M-224), 24 June 1983 (1983-06-24) & JP 58 055253 A (RICOH KK), 1 April 1983 (1983-04-01) abstract ----- -/-	1, 13, 20



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

\*8\* document member of the same patent family

Date of the actual completion of the international search

7 March 2006

Date of mailing of the international search report

17/03/2006

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel (+31-70) 340-2040, Tx. 31 651 epo.nl  
Fax (+31-70) 340-3016

Authorized officer

Van Oorschot, J

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2005/040288

## C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	EP 0 810 097 A (CITIZEN WATCH CO., LTD) 3 December 1997 (1997-12-03) column 11, line 1 - column 12, line 23 column 19, line 21 - line 30 -----	1,13,20
X	EP 0 375 147 A (AM INTERNATIONAL INCORPORATED) 27 June 1990 (1990-06-27) column 8, line 46 - column 9, line 43; figure 9 -----	1,13,20
X	EP 0 919 382 A (SONY CORPORATION) 2 June 1999 (1999-06-02) paragraphs '0138! - '0142!, '0157! - '0161!; figures 19,20 -----	1,13,20
A	US 2003/160836 A1 (FUKANO TAKAKAZU ET AL) 28 August 2003 (2003-08-28) paragraphs '0009!, '0011!, '0065!, '0068!, '0072!, '0081! - '0085!, '0092! - '0094! -----	1,13,20
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 223 (E-1075), 7 June 1991 (1991-06-07) & JP 03 065069 A (TOTO LTD), 20 March 1991 (1991-03-20) abstract -----	1,13,20

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2005/040288

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 2004000560	A	31-12-2003	CN 1662379 A EP 1515854 A1 JP 2004025510 A US 2005237350 A1	31-08-2005 23-03-2005 29-01-2004 27-10-2005
JP 2001010035	A	16-01-2001	JP 3669210 B2	06-07-2005
JP 58055253	A	01-04-1983	NONE	
EP 0810097	A	03-12-1997	DE 69601927 D1 DE 69601927 T2 WO 9718953 A1 US 5984448 A	06-05-1999 09-09-1999 29-05-1997 16-11-1999
EP 0375147	A	27-06-1990	CA 2004891 A1 JP 2215537 A US 5138333 A	19-06-1990 28-08-1990 11-08-1992
EP 0919382	A	02-06-1999	NONE	
US 2003160836	A1	28-08-2003	NONE	
JP 03065069	A	20-03-1991	NONE	

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

## PCT

### WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/US2005/040288

International filing date (day/month/year)  
04.11.2005

Priority date (day/month/year)  
05.11.2004

International Patent Classification (IPC) or both national classification and IPC  
B41J2/045

Applicant  
DIMATRIX, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability: citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



European Patent Office - P.B. 5818 Patentlaan 2  
NL-2280 HV Rijswijk - Pays Bas  
Tel +31 70 340 - 2040 Tx 31 651 epo nl  
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Authorized Officer

Van Oorschot, J

Telephone No +31 70 340-3044



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2005/040288

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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ in written format
    - ☐ in computer readable form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in computer readable form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2005/040288

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**Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	4,12
	No: Claims	1-3,5-11,13-23
Inventive step (IS)	Yes: Claims	4,12
	No: Claims	1-3,5-11,13-23
Industrial applicability (IA)	Yes: Claims	1-23
	No: Claims	

2. Citations and explanations

**see separate sheet**

**Re Item V.**

1. Reference is made to the following documents:

D1: WO 2004/000560A  
D2: JP2001010035A  
D3: JP58055253A  
D4: EP810097A  
D5: EP375147A  
D6: EP919382A

- 2.1 D1 shows a method of controlling a droplet ejection device comprising a switch (85/ASN page 29 line 22) that selectively couples a waveform input signal (Vcom / 77 / fig11A: P1-P2-P3) to a piezoelectric actuator (HN/52), the method comprising: during a droplet firing period (T0-T1-T2-T3), controlling the switch (85/ASN) to drive the piezoelectric actuator (HN/52) with the waveform input signal (Vcom: P1-P2-P3); and during a non-firing period (T3-T4; page 41 lines 22-25), controlling the switch (85/ASN) to drive the piezoelectric actuator (HN/52) with a constant voltage level (P31: page 41 lines 6-13: although the duration of re-charging by the flat level Vb becomes short, it is present during period T3-T4; alternatively page 31 lines 17-19), cf claim 1; wherein controlling the switch (85/ASN) is performed using two different control signals (ink ejection data D0-D1 and control signal CS including gate signals M0N-M1N-M2N-M3N), cf claim 2; comprising using a channel control signal (Vh11/Vh10/Vh01 or M3N/M2N/M1N) to control the switch (85/ASN) to drive the piezoelectric actuator (HN/52) with the waveform input signal (P1/P2/P3) and using a clamp control signal (Vh00 or M0N) to control the switch (85/ASN) to drive the piezoelectric actuator (HN/52) with the constant voltage level (flat Vb part of Vh00 fig 11E), cf claim 3; wherein the clamp control signal (flat Vb part of Vh00 fig 11E) prevents charge from leaking from the piezoelectric actuator (HN/52) when the droplet ejection device is off (at least during this time), cf claim 5; comprising selecting either the channel control signal (Vh11/Vh10/Vh01 or M3N/M2N/M1N) or the clamp control signal (flat Vb part of Vh00 fig 11E) to prevent

piezoelectric voltage drift, cf claim 6;  
wherein the channel control signal (M3N/M2N/M1N) and the clamp control signal (M0N) further control a plurality switches (G0,G1,G2,G3,G4/ASN), cf claim 7;  
wherein the plurality of switches comprise binary-weighted switches, cf claim 8;  
comprising logically combining the channel control signal (M3N/M2N/M1N) and the clamp control signal (M0N) to generate a single drive signal (in signal line from LSN to ASN) for controlling the switch (ASN), cf claim 9;  
comprising connecting the channel control signal (M3N/M2N/M1N) and the clamp control signal (M0N) to input terminals of an OR gate (G4), cf claim 10;  
wherein an output terminal of the OR gate (G4) comprises a single drive signal (in signal line from LSN to ASN) for controlling the switch (ASN), cf claim 11.

D1 like wise shows an apparatus for a droplet ejection device comprising:  
a piezoelectric actuator (HN/52);  
a switch (85/ASN) to selectively couple a waveform input signal (Vcom) with the piezoelectric actuator (HN/52); and  
a controller (figs 7-8) configured to control the switch (85/ASN) to drive the piezoelectric actuator (HN/52) with the waveform input signal (Vcom / 77 / fig11A: P1-P2-P3) during a droplet firing period (T0-T1-T2-T3) and drive the piezoelectric actuator (HN/52) with a constant voltage level (P31: page 41 lines 6-13: although the duration of re-charging by the flat level Vb becomes short, it is present during period T3-T4; alternatively page 31 lines 17-19) during a non-firing droplet period (T3-T4), cf claim 13;  
wherein the switch (ASN) comprises an input terminal (fig 8) to connect with the waveform input signal (Vcom/77), an output terminal (fig 8) to couple with the piezoelectric actuator (HN), a control signal terminal (G4-LSN-ASN) to control an electrical connection of the switch (ASN) using a first control signal (M3N/M2N/M1N) or a second control signal (M0N), wherein the waveform input signal comprises the constant voltage level (P31) when the second control signal (M0N) controls the switch (ASN), cf claim 14;  
wherein the controller (in particular DCN/84) is coupled with the control signal terminal of the switch (ASN/85), and wherein the controller uses the first control signal (M3N/M2N/M1N) and the second control signal (M0N) to control the switch (ASN), cf claim 15;

wherein the controller comprises an OR gate (G4) to logically connect the first control signal or the second control signal to the control signal terminal of the switch (ASN), cf claim 16;

wherein a first input of the OR gate (G4) is coupled to the first control signal (M3N/M2N/M1N), a second input of the OR gate (G4) is coupled to the second control signal (M0N), and an output of the OR gate (G4) is coupled to the control signal terminal of the switch (ASN), cf claim 17;

wherein the second control signal (M0N) controls the electrical connection of the switch (ASN) during non-firing droplet periods (T3-T4) of the droplet ejection device, cf claim 18;

wherein the first control signal (M3N/M2N/M1N) controls the electrical connection of the switch (ASN) during firing periods (T0-T1-T2-T3) of the droplet ejection device, cf claim 19;

D1 also shows a system to prevent voltage drift on a piezoelectric actuator (HN/52) of an inkjet printer, the system comprising:

a waveform driving circuit (77) to drive a voltage waveform (Vcom);

a switch (ASN/85) to electrically connect the waveform driving circuit (77) with the piezoelectric actuator (HN/52); and

a controller (figs 7/8) to control the switch (HN/52) during an ink ejection phase (T0-T1-T2-T3) and a non-ink ejection phase (T3-T4), wherein the waveform driving circuit drives a constant voltage waveform (P31: page 41 lines 6-13: although the duration of re-charging by the flat level Vb becomes short, it is present during period T3-T4; alternatively page 31 lines 17-19) during the non-ink ejection phase (T3-T4), cf claim 20.

wherein the controller is configured to electrically connect the waveform driving circuit (77) at an input of the switch (ASN) with the piezoelectric actuator (HN) at an output of the switch during the ink ejection phase (T0-T1-T2-T3) and during the non-ink ejection phase (T3-T4), cf claim 21;

wherein the controller comprises a first control signal (M3N/M2N/M1N) to control when the switch (ASN) is electrically connecting the piezoelectric actuator (HN/52) with the voltage waveform from the waveform driving circuit (77), cf claim 22.

wherein the controller comprises a second control signal (M0N) to control the switch (ASN) to electrically connect the waveform driving circuit (77) at an input of the switch

(ASN) with the piezoelectric actuator (HN/52) at an output of the switch (ASN) during the non-ink ejection phase (T3-T4), cf claim 23.

- 2.2 Also D2-D6 show at least the all the features of independent claims 1 ,13 and 20, see indications n the Search Report.
- 2.3 Therefore, the present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-3,5-11 and 13-23 is not new in the sense of Article 33(2) PCT.
3. In case the independent claims 1,13 and 20 would be considered or amended to include "during the complete non-firing period, controlling the switch to drive the piezoelectric actuator with a constant voltage level", then these claims would be considered not inventive, Art 33(2) PCT.

D1 refers on page 8 to D2 which selects a constant "bias level"  $V_m$  for a period T5 to T6. Likewise D3,D4,D5 and D6 use constant voltage levels for recharging. It must therefore be considered evident for a skilled person that also in D1 a constant voltage level would be a solution.

4. The combined features of claim 4 (plus 3): "wherein the clamp control signal prevents charge from accumulating on the piezoelectric actuator when the droplet ejection device is off" and of claim 12 : "wherein the voltage on the piezoelectric actuator is at a midrange between a ground potential and a supply potential during the non-firing period" are not known from the available documents.  
In particular in D1 only discharging from  $V_b$  downwards is prevented, and the voltage is kept near or at  $V_b$  thus not at a midrange.

Therefore such claim is considered as involving an inventive step (Article 33(3) PCT).

\*\*\*\*\*

# EUROPEAN PATENT OFFICE

## Patent Abstracts of Japan

PUBLICATION NUMBER : 2001010035  
PUBLICATION DATE : 16-01-01

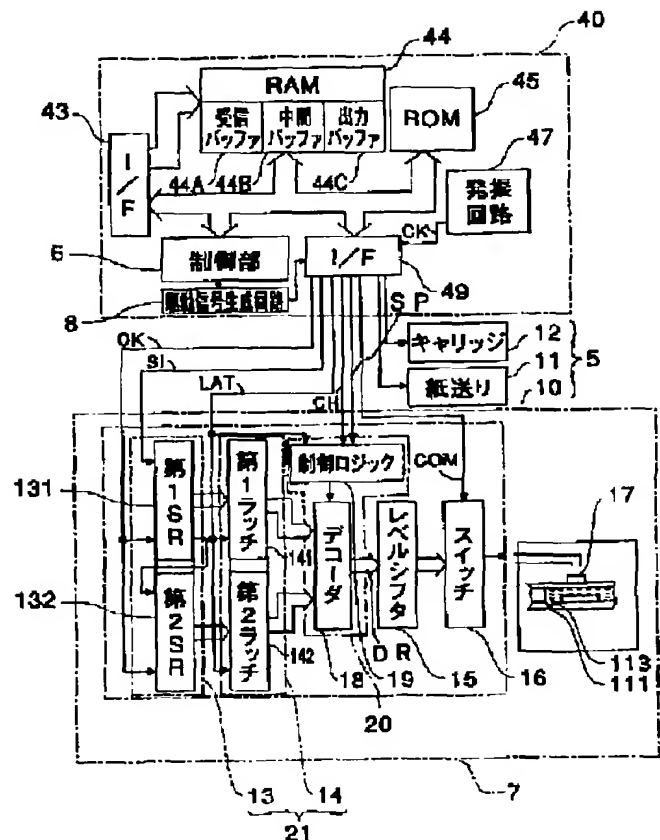
APPLICATION DATE : 25-06-99  
APPLICATION NUMBER : 11179902

APPLICANT : SEIKO EPSON CORP;

INVENTOR : ASAUCHI NOBORU;

INT.CL. : B41J 2/045 B41J 2/055

TITLE : INK JET RECORDER



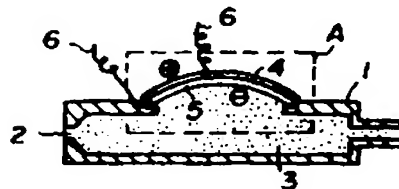
ABSTRACT : PROBLEM TO BE SOLVED: To provide an ink jet recorder capable of charging at an arbitrary timing to supplement natural discharging occurring at a pressure generating element.

SOLUTION: In the ink jet recorder, a head driving circuit 7 outputs a signal for applying an intermediate potential  $V_m$  to a pressure generating element 17 by selecting the potential  $V_m$  from a drive signal COM selectively for a period  $T_5$  to  $T_6$  to the element 17 (a pressure generating element 17 not discharging an ink droplet and a pressure generating element 17 for discharging an ink droplet having a large dot) charged to a potential coincident with the potential  $V_m$  of the signal COM, for example, for  $T_5$  to  $T_6$  of the elements 17. As a result, a potential of the element in which the potential is lowered from the potential  $V_m$  by natural discharging can be restored.

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## Patent Abstracts of Japan

TITLE : DRIVING METHOD FOR  
ELECTROSTRICTION VIBRATOR IN  
INK JET RECORDER



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## Patent Abstracts of Japan

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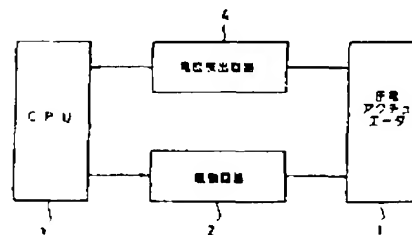
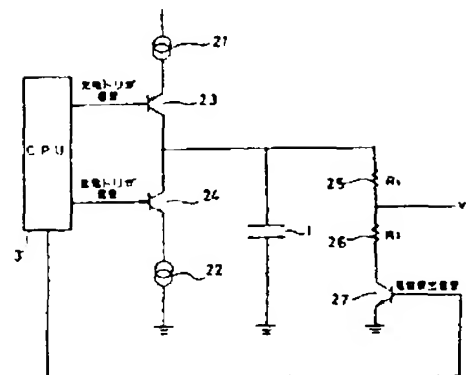
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INT.CL. : H02N 2/00 H01L 41/09

TITLE : DRIVER OF PIEZOELECTRIC ACTUATOR



ABSTRACT : PURPOSE: To accurately control the output displacement of a piezoelectric actuator accurately by charging the piezoelectric actuator with a constant current or discharging the actuator and by increasing and decreasing the potential of the actuator through charge or discharge to a target potential corresponding to a desired output displacement.

CONSTITUTION: An apparatus is equipped with a drive circuit 2 for charging a piezoelectric actuator 1 with a constant current or discharging the actuator, and the output of a central control unit (CPU) 3 for controlling the output of the drive circuit 2 via current control signal for controlling a charge or discharge time is connected with the input of the drive circuit 2. The apparatus is further equipped with a potential detection circuit 4 for detecting the potential of the piezoelectric actuator 1. Then, the potential of the piezoelectric actuator 1 is increased or decreased by charging the actuator with a constant current or discharging it to a target potential corresponding to a desired output displacement. In this manner, the variation of an output displacement due to the leakage of electric charge can be compensated and the accurate control of the piezoelectric actuator 1 is made possible.

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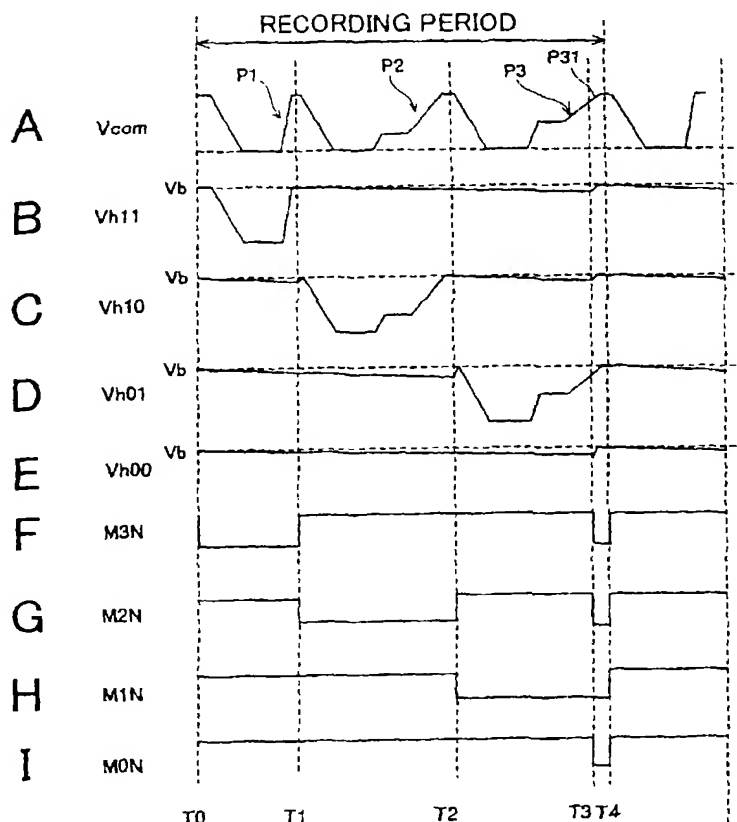
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(54) Title: HEAD CONTROL DEVICE AND IMAGE RECORDING APPARATUS



(57) Abstract: There is provided a head control device able to re-charge an electromechanical transducing element with a driving pulse without requiring an additional re-charging time period in a recording period. The driving signal includes a plurality of driving pulses, and in each recording period, at least one driving pulse includes a portion varying from a discharging level to a medium level to charge the piezoelectric element to eject a liquid droplet, and a subsequent portion varying from the medium level to a target level to re-charge the piezoelectric element to the target level.

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(57) A circuit for driving an ink-jet head comprising a common driving waveform generation circuit 11 for generating a driving voltage signal, an analog/digital converter circuit 12 for converting the driving voltage signal into driving waveform data, a gradation data separation/accumulation circuit 13 for separating printing gradation data contained in printing data therefrom, accumulating therein the separated printing gradation data temporarily, and outputting the separated printing gradation data at a predetermined timing, a comparator circuit 14 for comparing the printing gradation data with the driving waveform data and outputting a comparison signal. The circuit further comprises a printing control circuit 15 for judging presence of an ink discharge instruction signal contained in the printing data and outputting a switch control signal, a switch control circuit 16 for making a logical product by the comparison signal and the switch control signal, and outputting an analog switch control signal, and a bidirectional analog switch for controlling conductivity of the driving voltage signal so as to drive the piezoelectric actuator in accordance with the analog switch control signal. As a result, volume of ink droplets discharged from a nozzle can be controlled to comply with a picture image with density gradation, and free vibrations generated in the piezoelectric actuator are damped to thereby obtain ink droplets with a constant speed regardless of the size of the ink droplets.

The diagram, labeled "10 CIRCUIT FOR DRIVING INK-JET HEAD", shows the following components and connections:

- 11**: COMMON DRIVE WAVEFORM GENERATOR, connected to a VIB input and outputting a CF signal.
- 12**: ANALOG/DIGITAL CONVERTER CIRCUIT, receiving a PC signal from block 11 and outputting a PD signal to block 14a.
- 13**: GRADATION DATA SEPARATION/ACCUMULATION CIRCUIT, receiving a QD signal from block 14b and outputting a C1 signal to block 15.
- 14a**: DATA COMPARATOR CIRCUIT, receiving PD and 14b signals, outputting a 14c signal to block 17.
- 14b**: SWITCH CONTROL CIRCUIT, receiving a C2 signal from block 16 and outputting a C3 signal to block 17.
- 15**: PRINTING CONTROL CIRCUIT, receiving a C1 signal from block 13 and outputting a C0 signal to block 18.
- 16**: PRINTING DATA PROCESSOR CIRCUIT, receiving a C0 signal from block 18 and outputting a QD signal to block 13.
- 17**: BIDIRECTIONAL ANALOG SWITCH, receiving 14c and C3 signals, connected to a PVI input and outputting a signal to a piezoelectric actuator (31) via a nozzle (34).

(12)

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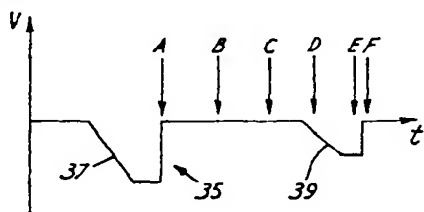
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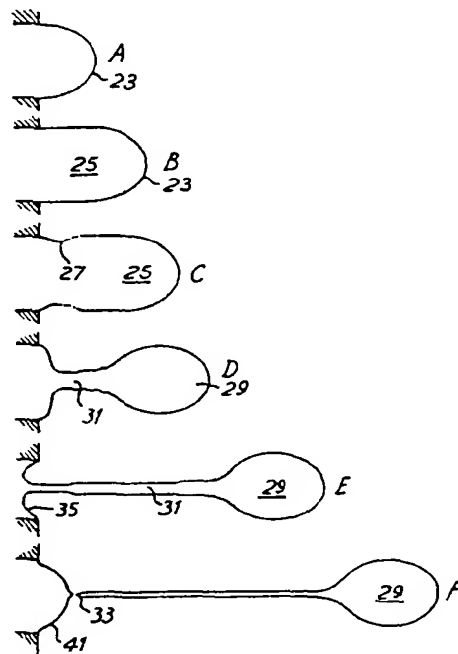
(54) **Method of operating pulsed droplet deposition apparatus.**

(57) A method of operating a pulsed droplet deposition apparatus for ejecting a liquid droplet from a nozzle supplied by a liquid retaining chamber comprises applying a first pulse (37) to the liquid in the chamber of sufficient energy to effect ejection of a droplet from the nozzle and thereafter applying a second pulse (39) to the liquid in the chamber to ensure that the meniscus (41) of the body of liquid to which the droplet is attached is convex in the direction of motion of the droplet at the time of detachment of the droplet. The energy content of the second pulse is insufficient of itself to effect droplet ejection. When employed in a multi-channel array printhead, the pulses applied to channels of the array selected for printing are produced e.g. by deflecting side walls of the selected channels or by applying heating pulses to liquid in the selected channels.

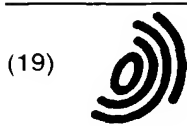
**EP 0 375 147 A2**



**FIG. 5**



**FIG. 6**



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(54) **Apparatus and method for driving recording head for ink-jet printer**

(57) An ink-jet printer and an apparatus and a method of driving a recording head for an ink-jet printer are provided for suppressing satellite droplets. Two piezoelectric elements are provided for every ink chamber corresponding to each nozzle. Timing of displacement of the piezoelectric elements is adjusted by applying a drive signal for ink droplet ejection to one of the piezo-

electric elements and a drive signal for suppressing satellite droplets when a droplet is ejected to the other piezoelectric element. An auxiliary pressure generated by the displacement of the latter piezoelectric element is superimposed on an ejection pressure generated by the displacement of the former piezoelectric element. Trailing of ink droplet is cut off at an early stage and generation of satellite droplets is suppressed.

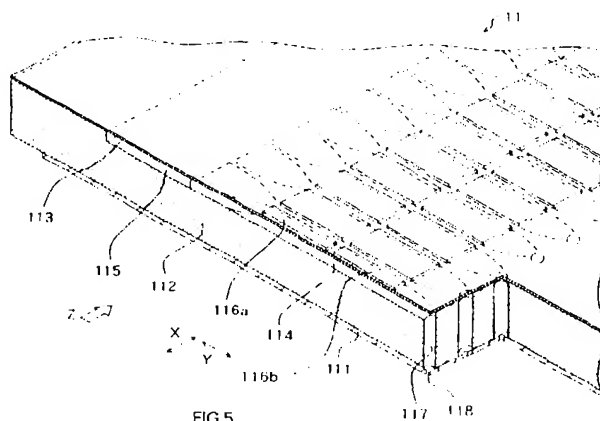


FIG. 5



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(19) **United States**(12) **Patent Application Publication**  
**Fukano et al.**(10) **Pub. No.: US 2003/0160836 A1**(43) **Pub. Date: Aug. 28, 2003**(54) **DEVICE AND METHOD FOR DRIVING  
JETTING HEAD**

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**Publication Classification**(75) Inventors: Takakazu Fukano, Nagano (JP);  
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2100 Pennsylvania Avenue, NW  
Washington, DC 20037-3213 (US)(57) **ABSTRACT**

There is disclosed a head driving device which drives a plurality of pressure generating elements for generating pressure fluctuation in a jetted object contained in each of associated pressure chambers formed in a jetting head of a jetting apparatus to eject the jetted object from each of nozzles communicated with the associated pressure chambers. In the device, a head driver generates a drive signal which is selectively applied to at least one of the pressure generating elements to be driven. A bias potential provider selectively applies a bias potential to at least one of the pressure generating elements not to be driven.

(73) Assignee: **SEIKO EPSON CORPORATION**(21) Appl. No.: **10/356,740**(22) Filed: **Feb. 3, 2003**(30) **Foreign Application Priority Data**

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